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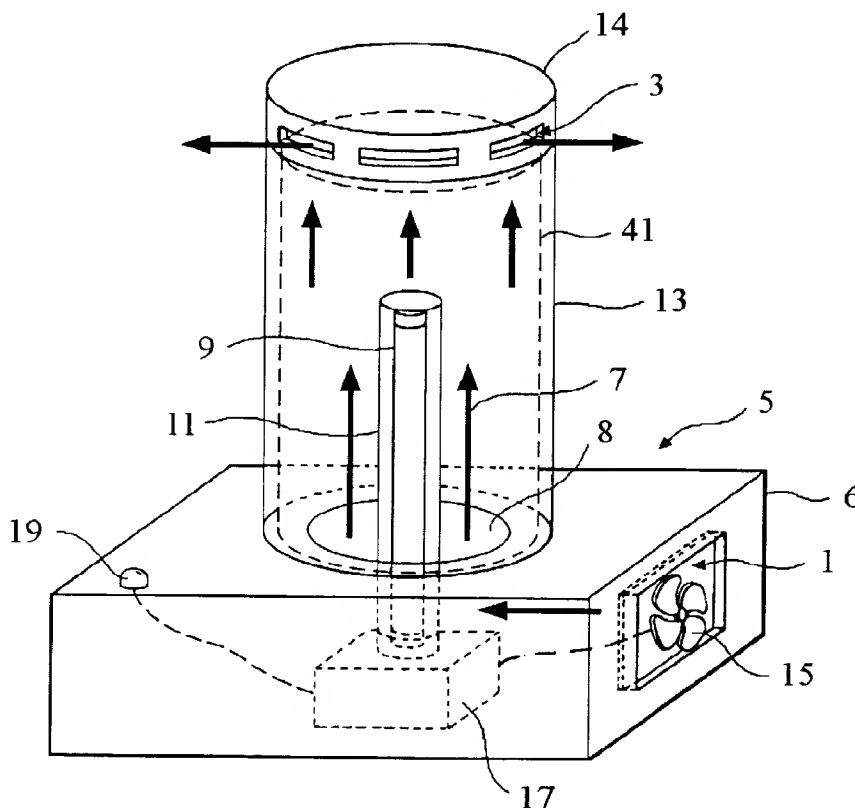
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(54) Title: ILLUMINATION APPARATUS FOR AIR PURIFICATION



(57) Abstract: The present invention relates to an illumination apparatus for air purification comprising a casing (5) with an air inlet (1) and an air outlet (3). An ultraviolet ray source (9) is positioned in an air passage in a direction between air inlet (1) toward air outlet (3). A transparent member (11) is arranged adjacent ultraviolet ray source (9) and applied with a photocatalyst on which a photochemical reaction is triggered when an ultraviolet ray is radiated thereon from ultraviolet ray source (9). A luminous section (13) forms a portion of casing (5) and emits light by absorbing ultraviolet rays penetrating transparent member (11). The inventive illumination apparatus for air purification is capable of purifying polluted indoor air with a photochemical reaction through the photocatalyst, using ultraviolet rays for illumination, while protecting humans from the ultraviolet rays.

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ILLUMINATION APPARATUS FOR AIR PURIFICATION

TECHNICAL FIELD

5 The present invention relates to an illumination apparatus for air purification and, more particularly, to an illumination apparatus for air purification having an ultraviolet lamp capable of being used as an illumination lamp and concurrently triggering a photochemical reaction for air purification with a photocatalyst.

BACKGROUND ART

10 In general, numerous illumination apparatuses using an ultraviolet lamp as an illumination lamp have been developed. However, ultraviolet rays emitted from ultraviolet lamps are harmful to humans, and use of ultraviolet lamps has been limited to commercial advertisement or ornamental purposes.

15 Accordingly, a problem exists in the art with the need for proper use of ultraviolet lamps in illumination apparatuses for home or office use.

DISCLOSURE OF THE INVENTION

20 It is an object of the present invention to provide an illumination apparatus for air purification capable of purifying polluted indoor air via a photochemical reaction by ultraviolet rays and using the ultraviolet rays for illumination, while protecting humans from the ultraviolet rays.

25 In order to achieve the above objects, the present invention provides an illumination apparatus for air purification which is in a casing having an air inlet and an air outlet. An ultraviolet ray source is positioned in an air passage in a direction between the air inlet toward said air outlet. A transparent member is disposed adjacent the ultraviolet ray source, and a photocatalyst is applied on the member and a photochemical reaction is triggered when ultraviolet rays from the ultraviolet ray source irradiates the photocatalyst. A luminous section forms a portion of the casing and emits light by absorbing the ultraviolet rays penetrating the transparent member.
30

The transparent member is preferably, a tube having both ends opened to allow an inside space thereof to form the air passage. Photocatalyst is applied on at least one of an internal or an external surface of the tube. In this case, the ultraviolet ray source may be positioned inside of the tube.

35 Further, the transparent member is preferably, a plurality of tubes, each of which is shorter in length than the ultraviolet ray source, arranged in a direction of

the air flow in the air passage, and has the photocatalyst applied thereon, and both ends opened.

The luminous section further comprises a fluorescent brightener or a luminescent pigment as one of the materials of which the luminous section is made.

5 In a modification, the luminous section can have a fluorescent brightener membrane or a luminescent pigment membrane applied thereon.

Alternatively, a paper containing a fluorescent brightener may be attached on an inner surface of the luminous section.

10 BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a perspective view of a first embodiment of the inventive illumination apparatus for air purification.

Fig. 2 is a perspective view of a modification embodiment of the inventive illumination apparatus for air purification.

15 Fig. 3 is a perspective view of a variation on the embodiment inventive illumination apparatus shown in Fig. 1.

Fig. 4a is a perspective view of a paper support member in accordance with the present invention.

20 Fig. 4b is a perspective view of the inventive illumination apparatus equipped with the paper support member shown in Fig. 4a.

Fig. 5 is a perspective view of a second embodiment of the inventive illumination apparatus for air purification.

Fig. 6 is a perspective view of a modification embodiment of the inventive illumination apparatus for air purification shown in Fig. 5.

25

MODES FOR CARRYING OUT THE INVENTION

A preferred embodiment of the present invention will now be described in detail with reference to the accompanying drawings.

30 Fig. 1 is a perspective view of a first embodiment of the inventive illumination apparatus for air purification. The inventive illumination apparatus for air purification shown in Fig. 1 includes a casing 5 provided with an air inlet 1 and an air outlet 3, an ultraviolet ray source 9 positioned in an air passage 7 in a direction from the air inlet 1 toward the air outlet 3, a transparent member 11 arranged adjacent the ultraviolet ray source 9, and a luminous window or a luminous section 35 13 forming a portion of the casing 5 and emitting light by absorbing the ultraviolet rays penetrating the transparent member 11.

The casing 5 includes the luminous section 13, and a lower main body 6 supporting the luminous section 13 and made of material which can block the ultraviolet rays emitted from the ultraviolet ray source 9. The luminous section 13 includes a cap 14 through which the plurality of air outlets 3 are formed. An air introduction fan 15 is mounted in the air inlet 1 which is formed in a flank portion of the lower main body 6 of the casing 5, to introduce air into the inside of the casing 5 from the outside. A filter (not shown) for filtering the pollutants from the introduced air may be mounted at the rear or front of the air introduction fan 15. Also, the air introduction fan 15 serves to dissipate heat emitted from the ultraviolet ray source 9 by continuously introducing the air into the casing 5. This may reduce the chance that a paper 41 described below and the luminous section 13, which are exposed to the ultraviolet ray source 9, catch fire.

An ordinary power supply device 17 for applying power to the ultraviolet ray source 9 and the air introduction fan 15 is equipped within the lower main body 6 of the casing 5. The power supply device 17 may be controlled using a switch 19 electrically connected to the power supply device 17 and positioned outside the casing 5.

A conventional ultraviolet lamp may be used as the ultraviolet ray source 9. The ultraviolet ray source 9 is disposed on top of power supply device 17 and is electrically connected to the power supply. As shown, a portion of the ultraviolet ray source 9 is in the lower main body 6, while the remainder protrudes into the luminous section 13 through an opening 8 of the lower main body 6.

Details on electronic circuits which applies power to air introduction fan 15 and ultraviolet ray source 9 from power supply device 17 are not included in this description as they are well known in the art.

The transparent member 11 shown in Fig. 1 is a glass tube having a blinded upper end and has therein the ultraviolet ray source 9. The transparent member 11 is installed upright on the power supply device 17 along the air passage 7. Photocatalyst is applied on an external surface of the transparent member 11 in order for a photochemical reaction with the ultraviolet ray radiated from the ultraviolet ray source 9. On the other hand, a layer of the photocatalyst applied on the transparent member 11 functions to reduce an amount of the ultraviolet ray penetrating the transparent member 11. Further, the transparent member 11 serves to protect the ultraviolet ray source 9 from any attempts to reach the ultraviolet ray source 9, thereby preventing hands of the children from being inadvertently touched to the ultraviolet ray source 9. The term "transparent member" referred in the

specification represents all materials through which the light transmission or diffuse transmission can occur. Accordingly, the transparent member is not limited to only the glass tube and for example, milky glass or the like having a property as a diffusate may be available as the transparent member employed in the present invention.

The luminous section 13 may be integrally formed with the lower main body 6 or detachably combined with the lower main body 6. The luminous section 13 is preferably, configured to include a fluorescent brightener as fluorescent material or a luminescent pigment as phosphorescent substance, as a luminescence means for emitting light by absorbing the ultraviolet ray. As an example where the luminescence means is applied to the luminous section 13, the luminescence means is applied on an entire surface of the luminous section 13 to be a membrane or the luminescence means may be one of the materials of which the luminous section 13 is made. Preferably, the luminous section 13 is an object on which the fluorescent brightener or the luminescent pigment is applied as a whole or is papers or synthetic resins having the fluorescent brightener as an internal additive. The use of the fluorescent brightener or the luminescent pigment as the luminescence means in the present invention is only exemplary suggestion and any material capable of emitting light by absorbing the ultraviolet ray may be used as the luminescence means in the present invention.

An operation of the inventive illumination apparatus for air purification is described hereunder.

Returning to Fig. 1, the polluted air is introduced from the outside into the air inlet 1 of the casing 5 by means of a suction force exerted by the air introduction fan 15. The introduced polluted air passes a lateral surface of the transparent member 11 applied with the photocatalyst along the air passage 7. The ultraviolet ray radiated from the energized ultraviolet ray source 9 transmits the wall of the transparent member 11 to be irradiated on the membrane of the photocatalyst applied on the lateral surface of the transparent member 11. The photocatalyst membrane irradiated with the ultraviolet ray triggers the photocatalyst reaction (the photochemical reaction) to derive an oxidation-reduction reaction of the harmful substances mixed in the polluted air. With this photocatalyst reaction, the harmful substances are decomposed into harmless substances. The purified air is flown along the air passage 7 and then is discharged from the casing 5 through the air outlet 3.

Further, the ultraviolet ray radiated from the ultraviolet ray source 9 is

irradiated on the luminous section 13 after transmitting the transparent member 11. When irradiated with the ultraviolet ray, the fluorescent brightener or the luminescent pigment, used as one of the materials of which the luminous section 13 is made or applied on the luminous section 13, absorbs the ultraviolet ray to change it into visible lights having predetermined colors and emits the visible light. Accordingly, since the luminous section 13 absorbs the ultraviolet ray, preventing the ultraviolet ray from being emitted to the outside when it is irradiated with the ultraviolet ray, the luminous section 13 can protect the humans from the ultraviolet ray. Further, since, when it is irradiated with the ultraviolet ray, the luminous section 13 emits the visible lights having predetermined colors to illuminate the surroundings, the inventive illumination apparatus for air purification has an illumination effect for ornamental purpose. Especially, the illumination effect for ornamental purpose may be increased by creating various colors including the predetermined colors in such a manner to apply on the luminous section 13 paint that can be obtained by properly mixing the fluorescent brightener with other pigment components.

In Figs. 2 and 3, there are shown other embodiments different from the inventive illumination apparatus for air purification shown in Fig. 1. The difference between these embodiments and the embodiment shown in Fig. 1 is a configuration of the transparent member. Hereunder, each embodiment will be described in detail with reference to Figs. 2 and 3.

Referring to Fig. 2, unlike the transparent member 11 shown in Fig. 1, the illustrated transparent member 21 is a through-tube having both ends opened and photocatalyst applied on an internal and an external surfaces of the tube, where an inside air passage 23 and an outside air passage 25 are formed inside and outside the tube, respectively. The inside air passage 23 includes an inlet 27 formed in a lower end thereof and an outlet 29 opened at an upper end of the transparent member 21.

The transparent member 21 shown in Fig. 2 has an advantage compared to the transparent member 11 shown in Fig. 1 in that it has a more widened photocatalyst-applied area to show a relatively increased efficiency in purifying the polluted air, since the photocatalyst is applied on both internal and external surfaces of the transparent member 21.

On the other hand, referring to Fig. 3, unlike the transparent members 11 and 21 shown in Figs. 1 and 2, respectively, a transparent member 31 is a plurality of tubes, each of which is shorter in length than the ultraviolet ray source 9, arranged in a direction of the air flow, and has the photocatalyst applied thereon and both ends opened. The plurality of transparent members 31 are accommodated in a

transparent hollow accommodation member 35. The transparent accommodation member 35 includes an inner tube 35a surrounding the ultraviolet ray source 9, an outer tube 35b coaxially separated from the inner tube 35a by a predetermined distance in radial direction and a support plate 37 mounted to a lower end of the transparent accommodation member 35 and having a plurality of grid holes formed therethrough. The support plate 37 serves to support the transparent members 31, allowing the transparent members 31 to be arranged in the transparent accommodation member 31.

The transparent member 31 has an advantage compared to the transparent members 11 and 21 shown in Figs. 1 and 2, respectively, in that it has a more widened photocatalyst-applied area to show a relatively increased efficiency in purifying the polluted air.

Fig. 4a is a perspective view of a paper support member 39 in accordance with the present invention. The paper support member 39 facilitates mounting a paper adjacent an inner wall of the inventive luminous section 13. The paper is, for example, a wood-free printing paper that may be obtained by adding the fluorescent brightener to the paper raw material, or a paper on which the fluorescent brightener or the luminescent pigments is applied. The paper support member 39 includes a pair of band like resilient support plates 45 and 47 rotatable with respect to each other via a hinge 43. A protuberance 45a is formed on an end of the support plate 45, whereas a receiving hole 47a into which the protuberance 45a is inserted is formed through an end of the support plate 47. Further, a plurality of lugs 49 are formed on an outer surface of the support plate 45, i.e., a surface opposite to the surface on which the paper is contacted.

Referring to Fig. 4a, when the protuberance 45a of the support plate 45 is inserted into the receiving hole 47a of the support plate 47 by rotating the support plate 45 toward the support plate 47 about the hinge 43, an upper end of the paper is sandwiched between the support plates 45 and 47 to be fixed therebetween. After the support plates 45 and 47 are rolled into a circular form, the support plates 45 and 47 can be resiliently and closely contacted on the inner wall of the luminous section 13 by firstly locating the roll of the support plates 45 and 47 in the luminous section 13 and by secondly removing a force maintaining the circular form. During this process, the plurality of lugs 49 are engaged into receiving grooves 51 formed on the upper side of the luminous section 13, respectively, resulting in a more stable connection of the support member 39 onto the luminous section 13.

As described above, the paper 41 mounted adjacent the inner wall of the

luminous section 13 together with the luminous section 13 absorbs the ultraviolet ray radiated from the ultraviolet ray source to efficiently block the ultraviolet ray emitting outside. Further, the paper 41 has a luminescence effect caused by the fluorescent brightener or the luminescent pigment contained therein.

5 On the other hand, although it is described in the description that the paper 41 is mounted to the luminous section 13 by means of the support member 39, the paper 41 may be installed on the luminous section 13 in various manners, e.g., attaching the paper on the luminous section 13 with adhesive without using the support member 39 as shown in Fig. 1.

10 Fig. 5 is a perspective view of a second embodiment of the inventive illumination apparatus for air purification. The illustrated illumination apparatus for air purification includes a casing 57 provided with an air inlet 53 and an air outlet 55, an ultraviolet ray source 61 position in an air passage 59 from the air inlet 53 toward the air outlet 55, a transparent member 63 arranged adjacent the ultraviolet
15 ray source 61, and a luminous window or an luminous section 65 forming a portion of the casing 57 and emitting light by absorbing the ultraviolet rays penetrating the transparent member 63.

 The casing 5 includes the luminous section 65, and a main body 67 having an opened upper end covered with the luminous section 65 and made of material that
20 can block the ultraviolet ray radiated from the ultraviolet ray source 61. An air introduction fan 59 is mounted in the air inlet 53 of the casing 57, to introduce air into the inside of the casing 57 from the outside. A filter (not shown) for filtering the pollutants from the introduced air may be mounted to a rear or a front of the air introduction fan 69.

25 An ordinary power supply device 71 that applies a power to the ultraviolet ray source 61 and the air introduction fan 69 is equipped within the casing 57. The power supply device 71 may be controlled using a switch (not shown) electrically connected to the power supply device 71 and positioned outside the casing 57.

 Unlike the ultraviolet ray source 9 shown in Fig. 1, the ultraviolet ray source
30 61 of this embodiment is mounted between a pair of supports 73 opposite to each other, with both ends thereof being separated from a bottom of the main body 67 by a predetermined distance.

 A transparent member 63 is a glass tube having both ends supported by the supports 73 with the ultraviolet ray source 61 positioned therein, and arranged across
35 an air passage 59. Photocatalyst is applied on an external surface of the transparent member 63 in order for the photochemical reaction with the ultraviolet ray radiated

from the ultraviolet ray source 61.

The luminous section 67 may be detachably combined with the main body 67. The luminous section 65 is preferably, configured to include the fluorescent brightener or the luminescent pigment, as a luminescence means for emitting light by absorbing the ultraviolet ray. Since the material of which the luminous section 65 is made and the function of the luminous section 65 are the same as those of the luminous section 13 shown in Fig. 1, the description about that is omitted.

An operation of the inventive illumination apparatus for air purification as described above is described hereunder.

Returning to Fig. 5, the polluted air is introduced from the outside into the air inlet 53. Next, the introduced polluted air passes an external lateral surface of the transparent member 63 applied with the photocatalyst along the air passage 59. The ultraviolet ray radiated from the ultraviolet ray source 61 transmits the wall of the transparent member 63 to be irradiated on the membrane of the photocatalyst applied on the external lateral surface of the transparent member 63. The photocatalyst membrane irradiated with the ultraviolet ray triggers the photocatalyst reaction to derive an oxidation-reduction reaction of the harmful substances mixed in the polluted air. With this photocatalyst reaction, the harmful substances are decomposed into harmless substances. The purified air is flown along the air passage 59 and then is discharged from the main body 67 through the air outlet 55.

On the other hand, the ultraviolet ray radiated from the ultraviolet ray source 61 is irradiated on the luminous section 65 after transmitting the transparent member 63. When irradiated with the ultraviolet ray, the fluorescent brightener or the luminescent pigment, used as material of which the luminous section 65 is made or applied on the luminous section 65, absorbs the ultraviolet ray to change it into visible lights having predetermined colors and emits the visible light. Accordingly, when it is irradiated with the ultraviolet ray, the luminous section 65 absorbs the ultraviolet ray to prevent the ultraviolet ray from being emitted to the outside and the luminous section 65 emits the visible lights having predetermined colors to illuminate the surroundings. Especially, in order to enhance the absorption of the ultraviolet ray by the luminous section 65, a paper 81, e.g., a paper that may be obtained by adding the fluorescent brightener to the paper raw material, or a paper on which the fluorescent brightener or the luminescent pigments is applied, may be attached on the inner wall of the luminous section 65.

Fig. 6 is a perspective view of another embodiment different from the inventive illumination apparatus for air purification shown in Fig. 5. The difference

between this embodiments and the embodiment shown in Fig. 5 is a configuration of the transparent member.

Referring to Fig. 6, unlike the transparent member 63 shown in Fig. 5, the illustrated transparent member 75 is a plurality of tubes, each of which is shorter in length than the ultraviolet ray source 61, arranged in a direction of the air flow in an air passage 77 and has the photocatalyst applied thereon and both ends opened. The plurality of transparent members 77 are arranged in parallel with each other with the ultraviolet ray source 61 being sandwiched therebetween and are supported between a pair of support plates 79. The support plates 79 are separated from each other in a vertical direction and are fixed at their ends to the supports 73, respectively. Each of the support plates 79 has a plurality of grid holes formed therethrough.

The transparent member 75 has an advantage compared to the transparent member 63 shown in Fig. 5 in that it has a more widened photocatalyst-applied area to show a relatively increased efficiency in purifying the polluted air.

While the present invention has been described with reference to its preferred embodiments, it will be apparent to those skilled in the art that variations and modifications are possible without deviating from the broad principles and teachings of the present invention which are defined by the following claims.

In accordance with the inventive illumination apparatus for air purification as described above can purify the indoor polluted air by using a photocatalyst reaction triggered by the ultraviolet ray. At the same time, the inventive illumination apparatus for air purification is adapted to prevent the ultraviolet ray from being emitted to the outside to reduce a bad influence on the humans which may occur when the human body is exposed to the ultraviolet ray. Further, the inventive illumination apparatus for air purification has a unique illumination effect for ornamental purpose by the luminescent means including the ultraviolet ray and the fluorescent brightener.

CLAIMS

1. An illumination apparatus for air purification, comprising:
a casing further comprising an air inlet and an air outlet;
5 an ultraviolet ray source positioned in an air passage in a direction between said air inlet and said air outlet;
a transparent member disposed adjacent said ultraviolet ray source, the member applied with a photocatalyst on which a photochemical reaction is triggered when an ultraviolet ray is radiated thereon from said ultraviolet ray source; and
10 a luminous section forming a portion of said casing, the section emitting light by absorbing said ultraviolet rays which penetrate said transparent member.
2. The illumination apparatus for air purification of Claim 1, wherein said transparent member is a tube having both ends opened to allow an inside space
15 thereof to form said air passage and said photocatalyst is applied to at least one of an internal surface and an external surface of the tube.
3. The illumination apparatus for air purification of Claim 2, wherein said ultraviolet ray source is positioned within said tube.
20
4. The illumination apparatus for air purification of Claim 1, wherein said transparent member is a plurality of tubes; and each tube is shorter in length than said ultraviolet ray source, is arranged in a direction of air flow in said air passage, has said photocatalyst applied thereon, and has both ends open.
25
5. The illumination apparatus for air purification of any one of Claims 1 to 4, wherein said luminous section is made of a fluorescent brightener or a luminescent pigment.
- 30 6. The illumination apparatus for air purification of any one of Claims 1 to 4, wherein said luminous section further comprises a fluorescent brightener membrane or a luminescent pigment membrane applied thereon.
7. The illumination apparatus for air purification of any one of Claims 1 to 4,
35 further comprising a paper containing therein a fluorescent brightener and attached on an inner surface of said luminous section.

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Fig. 1

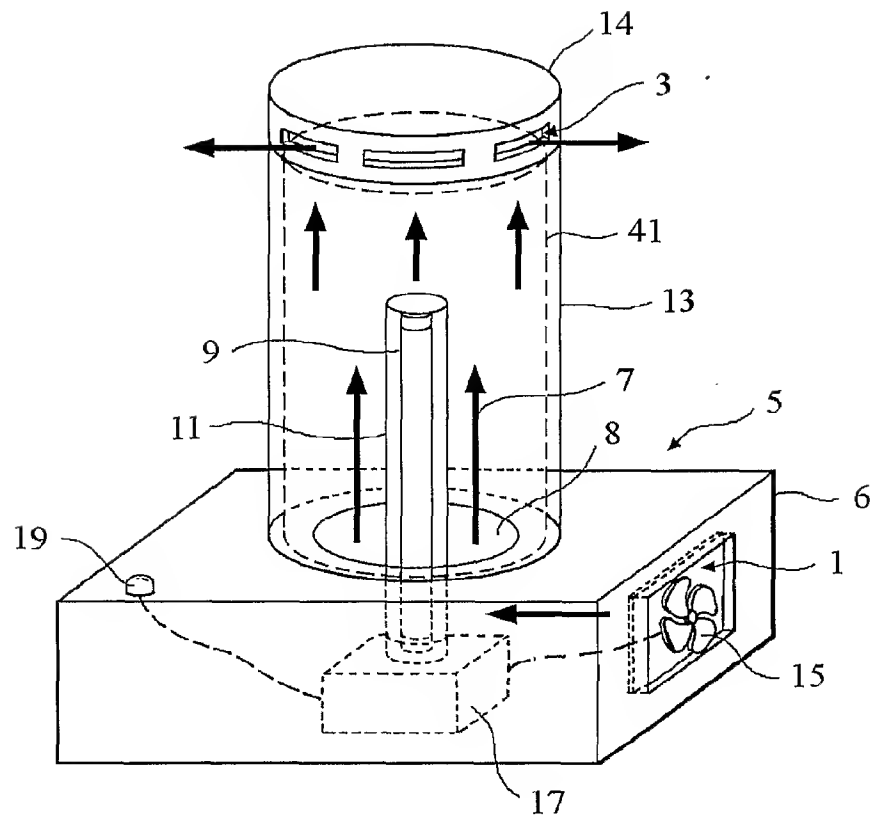
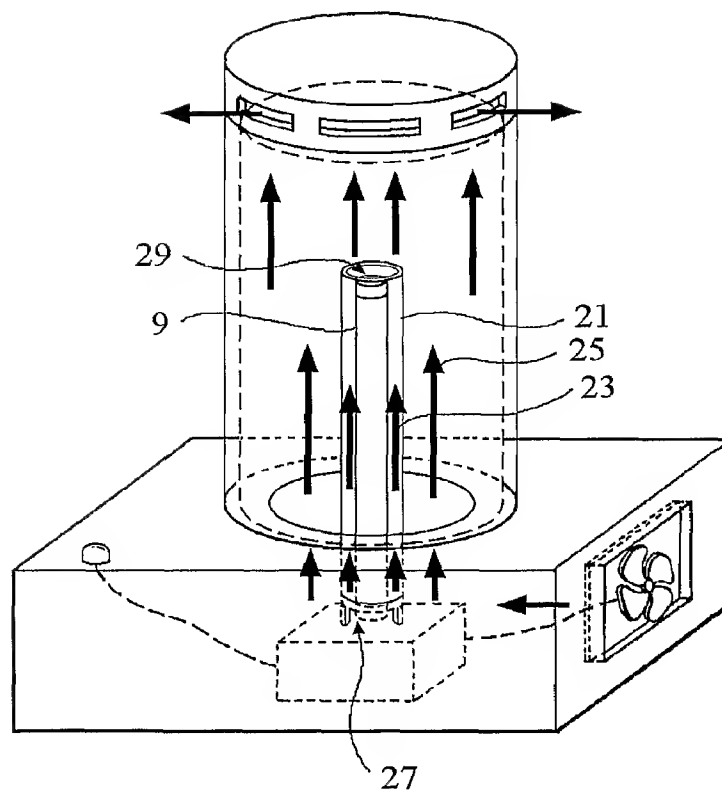
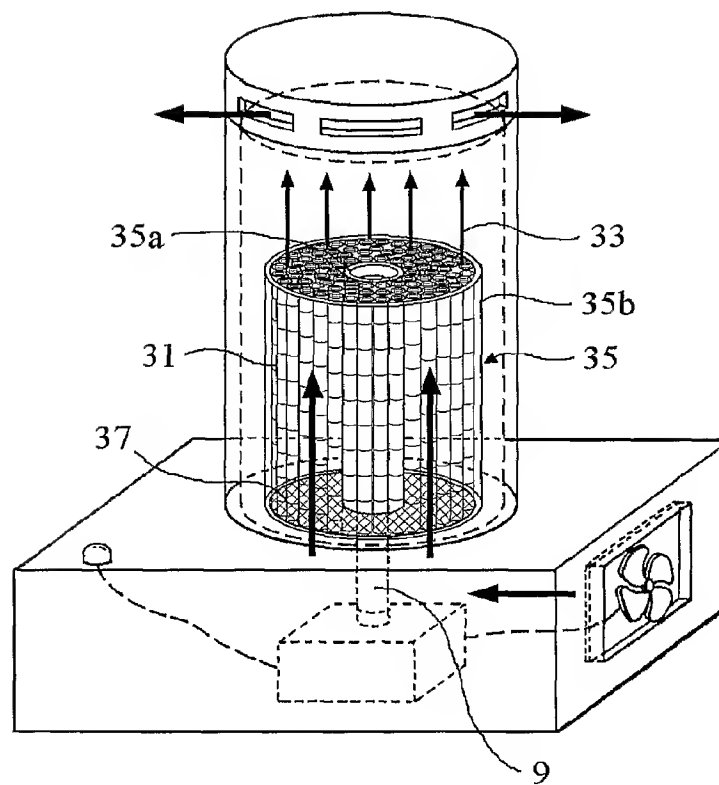


Fig. 2



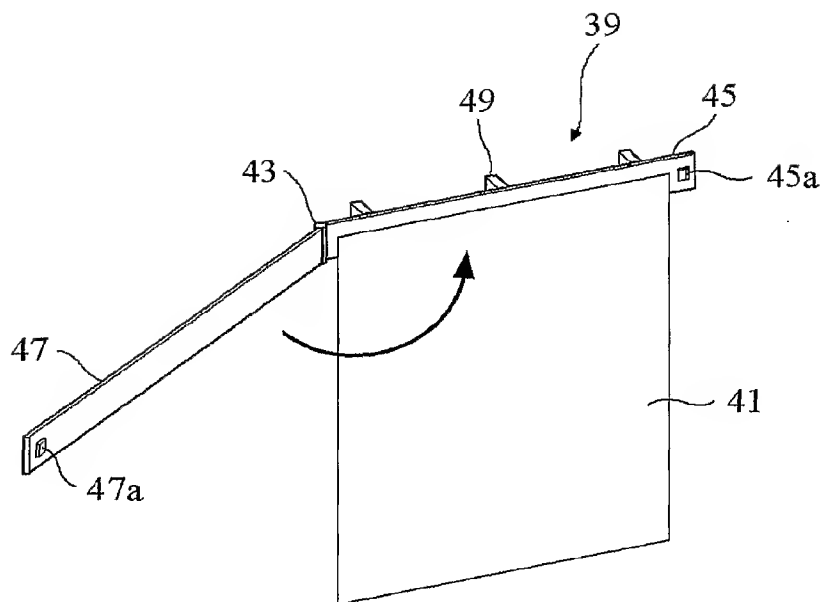
3/7

Fig. 3



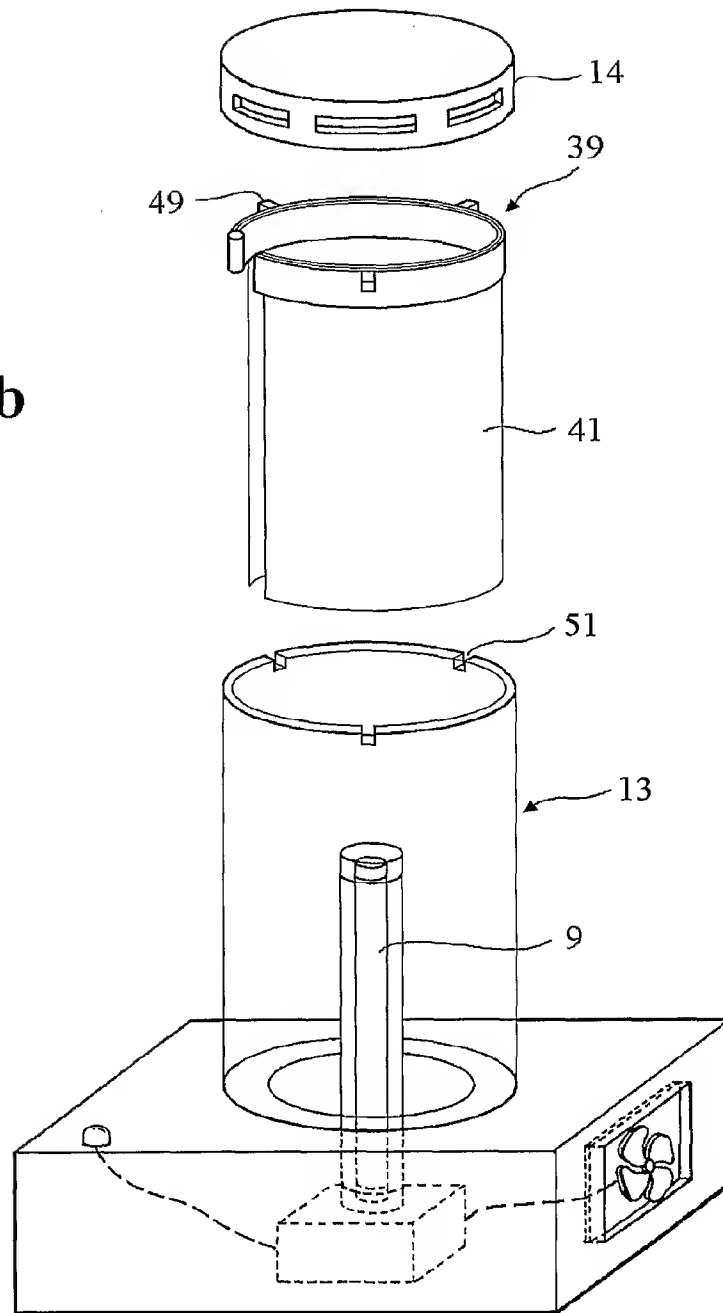
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Fig. 4a



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Fig. 4b



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Fig. 5

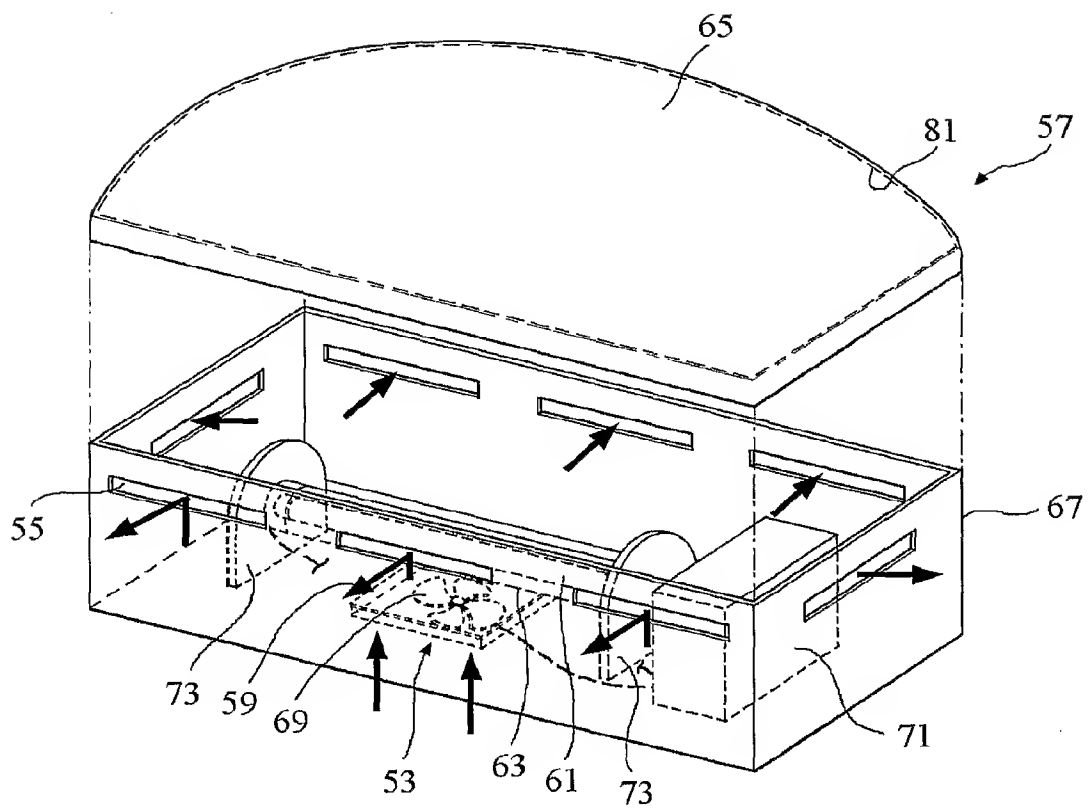
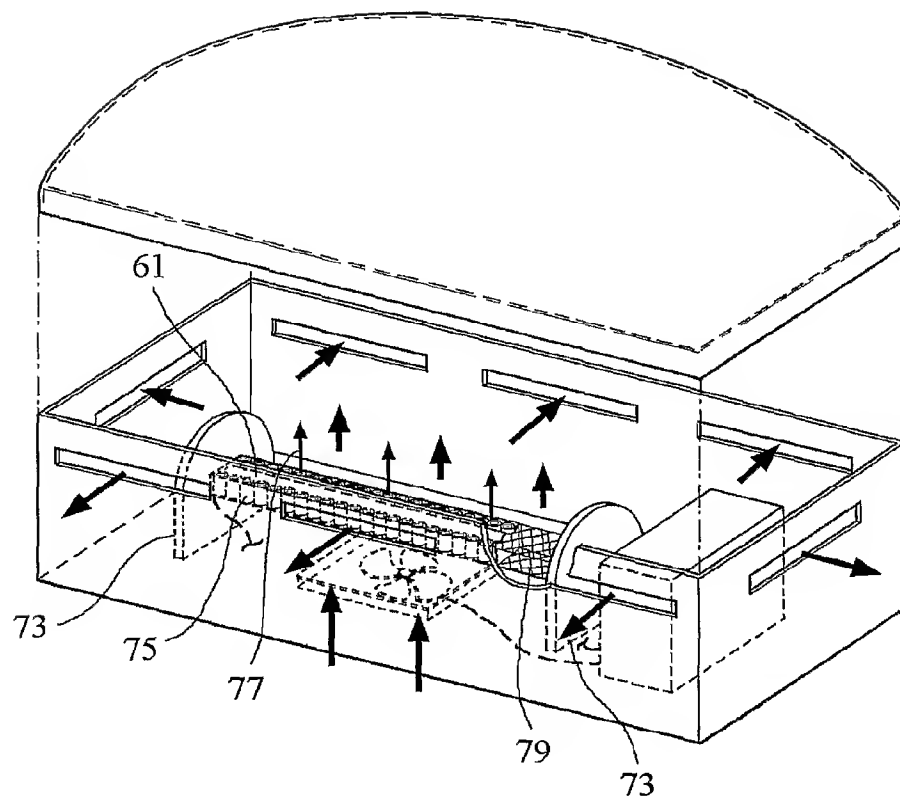


Fig. 6



INTERNATIONAL SEARCH REPORT

International application No.
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A. CLASSIFICATION OF SUBJECT MATTER

IPC7 B01D 53/86, H01J 1/00, F21V 8/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 B01D, F21

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Korean Patents and Applications for Inventions since 1975

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

NPS, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 09-180528 A (TOSHIBA LIGHTING & TECHNOL CORP) 11 July 1997 see the whole document	1-7
A	JP 12-228112 A (NEC HOME ELECTRONICS LTD) 15 August 2000 see the whole document	1-7
A	JP 08-273611 A (TOSHIBA LIGHTING & TECHNOL CORP) 10 October 1996 see the whole document	1-7
A	JP 12-100221 A (TOTO LTD) 7 April 2000 see the whole document	1-7
A	JP 10-149708 A (JAPAN AVIATION ELECTRON IND LTD) 2 June 1998 see the whole document	1-7

☐ Further documents are listed in the continuation of Box C.

☐ See patent family annex.

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